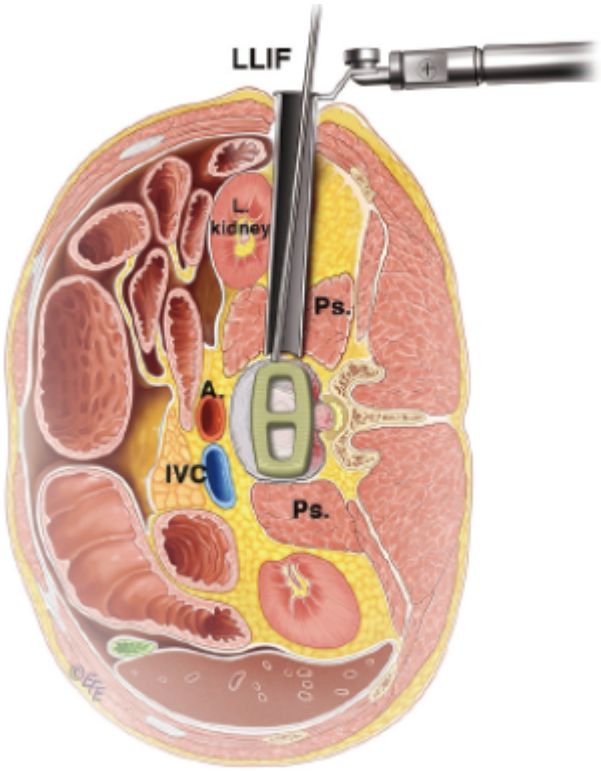
# Lateral lumbar interbody fusion (LLIF)




see also Extreme Lateral lumbar interbody fusion.

E.g. XLIF, DLIF, OLIF. Approach through psoas muscle (XLIF, DLIF) or anterior to psoas muscle (OLIF) through a lateral or anterolateral approach. It can distract the vertebral bodies by increasing the height of the disc space and thereby indirectly decompressing the neural elements. If bone quality is good, and there is no instability nor spondylolisthesis > Grade I, a stand-alone procedure (i.e. without screw instrumentation) may be an option if cage width of at least 22 mm (or preferably 26 mm) in the AP dimension is used.

LLIF was more effective than TLIF for spondylolisthesis reduction, likely due to the higher profile cage and ligamentotactic effect. In addition, LLIF showed mechanical stability of the reduction level by using a cage with a larger footprint. Therefore, LLIF should be considered a surgical option before TLIF for patients with unstable DS [1].

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Integration of spinal navigation and robotic assistance appears feasible, accurate, and safe as an alternative to fluoroscopic guidance for single-position LLIF [2].

## Advantages

Lateral lumbar interbody fusion (LLIF) is a minimally invasive technique first described by Ozgur et al. [3]. LLIF allows the surgeon to access the intervertebral space via a minimally invasive direct lateral approach through the psoas muscle. The advantage of LLIF over the traditional anterior approach is the avoidance of exposure of the abdominal viscera, large vessels, and sympathetic plexus. Injury to

the nerve roots and dura, and perineural fibrosis, which can occur after PLIF or TLIF, are minimized with this technique [4]. [5].

# Indications

Used to treat leg pain or back pain generally caused by degenerative disc disease.

LLIF has been utilized to treat a variety of pathologies including adult degenerative scoliosis, central and foraminal stenosis, spondylolisthesis, and adjacent segment degeneration

They have become an increasingly popular surgical technique due to the benefits of minimal tissue disruption, excellent disc visualization, ability to insert a large intervertebral cage to lessen subsidence, and faster recovery times [6] [7].

## Position

The LLIF procedure differs from other lumbar procedures in that the patient is positioned in the lateral decubitus position, often times utilizing bending the bed near the iliac crest region in order to facilitate access to the L4-5 disc space.

In awake volunteers, the pressure at the iliac crest or greater trochanter at the break of the bed increases by increasing the bed angle. Women with a lower BMI had high VAS pain scores when their greater trochanter was at maximal bed break. Men with higher BMI had high VAS pain scores when their iliac crest was at maximal bed break. An awareness of the iliac crest or greater trochanter at the break of the bed should be considered to prevent pain and increased pressure based on the patient's sex and BMI [8].

As with most minimally invasive spine procedures, lateral lumbar interbody fusion (LLIF) requires the use of biplanar fluoroscopy for localization and safe interbody cage placement. Computed tomography (CT)-based intraoperative spinal navigation has been shown to be more effective than fluoroscopic guidance for posterior-based approaches such as pedicle screw instrumentation.

Use of an intraoperative cone-beam CT with an image-guided navigation system is feasible and safe and appears to be accurate, although a larger study is required to confirm these results [9].

# Complications

see Lateral lumbar interbody fusion complications.

# Cost effectiveness

TLIF and LLIF produced equivalent 2-year patient outcomes at an equivalent cost-effectiveness profile [10].

# Systematic reviews

Transpsoas lateral interbody fusion is one of the Lateral Lumbar Interbody Fusion minimally invasive approaches for lumbar spine surgery. Most surgeons insert the interbody cage laterally and then insert pedicle or cortical screw and rod instrumentation posteriorly. However, stand-alone cages have also been used to avoid posterior instrumentation.

The literature on comparison of the two approaches is sparse.

Alvi et al., performed a systematic review and meta-analysis of the available literature on transpsoas lateral interbody fusion by an electronic search of the PubMed, EMBASE, and Scopus databases using PRISMA guidelines. They compared patients undergoing transpsoas standalone fusion (TP) with those undergoing transpsoas fusion with posterior instrumentation (TPP).

A total of 28 studies with 1462 patients were included. Three hundred and seventy-four patients underwent TPP, and 956 patients underwent TP. The mean patient age ranged from 45.7 to 68 years in the TP group, and 50 to 67.7 years in the TPP group. The incidence of reoperation was found to be higher for TP (0.08, 95% confidence interval [CI] 0.04-0.11) compared to TPP (0.03, 95% CI 0.01-0.06; $p = 0.057$). Similarly, the incidence of cage movement was found to be greater in TP (0.18, 95% CI 0.10-0.26) compared to TPP (0.03, 95% CI 0.00-0.05; $p < 0.001$). Oswestry Disability Index (ODI) and visual analog scale (VAS) scores and postoperative transient deficits were found to be comparable between the two groups.

These results appear to suggest that addition of posterior instrumentation to transpsoas fusion is associated with decreased reoperations and cage movements. The results of previous systematic reviews and meta-analysis should be reevaluated in light of these results, which seem to suggest that higher reoperation and subsidence rates may be due to the use of the standalone technique [11].

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A systematic and critical review of recent literature was conducted in accordance with PRISMA guidelines. The sources of the data were PubMed, MEDLINE, Embase, Cochrane and Scopus. Key search terms were “transpsoas”, “interbody fusion”, “LLIF”, “XLIF” and “spondylolisthesis”. Papers included in the review were original research articles in peer-reviewed journals. The articles were thoroughly examined and compared on the basis of study design, outcomes, and results. Only studies which met the eligibility criteria were included. Eight studies were included in the qualitative and quantitative analysis (three retrospective, four prospective, one randomized controlled trial). A total of 308 patients (227 females) (pooled age 64.5 years) and a total of 353 operated levels were analyzed. Mean follow up time ranged from 6.2 to 24 months. There were no reported cases of durotomies or pseudarthrosis in any study. All neurologic complications were reported to be transient with no permanent deficits. Mean improvement in ODI scores ranged between 19.5 (38.6%) to 36 (54.5%). Mean improvement in slip ranged from 47 to 67.5%. Three studies also reported that patient satisfaction and willingness to undergo the procedure again approached 90%. Minimally invasive transpsoas interbody fusion possibly leads to favorable clinical and radiological outcomes while avoiding the possible complications of its more traditional open and minimally invasive counterparts. Further studies are needed to better establish its role in the management of low grade degenerative lumbar spondylolisthesis [12].

# Most cited articles

Kolb et al. analyzed the literature to identify the 25 most cited articles regarding lateral lumbar interbody fusion. The Thomson Reuters Web of Science was systematically searched to identify papers pertaining to lateral lumbar interbody fusion. The results were sorted in order to identify the top cited 25 articles. Statistical analysis was applied to determine metrics of interest, and observational studies were further classified. A search of all databases in the Thomson Reuters Web of Science identified 379 articles pertaining to lateral lumbar interbody fusion, with a total of 3800 citations. Of the 25 most cited articles, all were case series, reporting on a total of 2981 patients. These 25 articles were cited 2232 times in the literature and total citations per article ranged from 29 to 433. The oldest article was published in 2006, whereas the most recent article was published in 2015. The most cited article, by Ozgar et al., was cited 433 times, and the journal Spine published 7 of the 25 most cited articles. Herein, they reported and analyzed the 25 most cited articles on lateral lumbar interbody fusion, which include 25 cases series reporting a variety of data on a total of 2513 patients. Such data might assist in the design and interpretation of future studies pertaining to this topic [13].

# Case series

see Minimally invasive lateral lumbar interbody fusion case series.

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